656

CHAPTER 8

DOMESTIC DOGS IN WILDLIFE HABITATS

EFFECTS OF RECREATION ON ROCKY MOUNTAIN WILDLIFE

A Review for Montana

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ABSTRACT

It is difficult to segregate human demographic trends from trends in rural development and outdoor recreational participation in settings like the West where they appear to be interrelated. One extension of human recreation in wildlife habitats is the effect of disturbance, harassment, displacement, or direct mortality of wildlife attributable to domestic dogs that accompany recreationists. At some level, domestic dogs still maintain instincts to hunt and/or chase. Given the appropriate stimulus, those instincts can be triggered in many different settings. Even if the chase instinct is not triggered, dog presence in and of itself has been shown to disrupt many wildlife species. Authors of many wildlife disturbance studies concluded that dogs with people, dogs on-leash, or loose dogs provoked the most pronounced disturbance reactions from their study animals. During winter, concerns are primarily related to human activity on ungulate winter ranges. Dogs extend the zone of human influence when off-leash. Many ungulate species demonstrated more pronounced reactions to unanticipated disturbances, as a dog off-leash would be until within very close range. In addition, dogs can force movement by ungulates (avoidance or evasion during pursuit), which is in direct conflict with overwinter survival strategies which promote energy conservation. During summer, concerns are primarily related to the birth and rearing of young for all wildlife species. Dogs are noted predators for various wildlife species in all seasons. Domestic dogs can potentially introduce diseases (distemper, parvovirus, and rabies) and transport parasites into wildlife habitats. While dog impacts to wildlife likely occur at the individual scale, the results may still have important implications for wildlife populations. For most wildlife species, if a "red flag" is raised by pedestrian-based recreational disturbance, there could also be problems associated with the presence of domestic dogs. Managers may consider the following when evaluating recreational impacts of dogs in wildlife habitats: species biology, reproductive potential, abundance, density, distribution, degree of habitat specificity or reliance on certain habitat components, and predisposition and sensitivity to disturbance by other agents. This information is intended to increase awareness among natural resource professionals and the public about the potential implications of uncontrolled domestic dogs in wildlife habitats and to encourage responsible outdoor recreation ethics.

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INTRODUCTION

One extension of human recreation in wildlife habitats is the effect of harassment, displacement, or direct mortality of wildlife attributable to uncontrolled domestic pets. Many recreationists take their dogs along while hiking, biking, skiing, or snowshoeing. Although firewood cutting is not typically thought of as recreational in nature, this activity also puts people into wildlife habitats. Some firewood cutters bring their dogs and allow them to run. Their reasons for doing so include advance warnings of bears or lions, exercise for the dog, and companionship. These dogs also have the potential to harass wildlife. Similarly, some antler collectors intentionally allow their dogs to run while searching ungulate winter range, in the belief that the search will be more thorough, wide-ranging, and efficient because of the dog's sensitive nose and cruising behavior. There is emerging interest in sled-dog recreation and competition in Rocky Mountain states. This activity also introduces domestic dogs into wildlife habitats.

The primary objective of this chapter is to increase the awareness among natural resource professionals and the public about the potential implications of uncontrolled domestic dogs in wildlife habitats and to summarize information, where available, about documented impacts. Secondarily, the objective is to encourage resource managers to proactively consider the issue, despite the inadequacies of current information.

Some recreationists maintain control of their dogs through leash restraint while others consider voice command a form of control. Still others make little attempt to maintain control of their dogs, allowing them to travel out of sight and/or hearing distance. Despite human efforts to domesticate dogs during the past 11-12,000 years and our contemporary attempts at rigorous voice-command training, dogs still maintain instincts to hunt and/or chase. Given the appropriate stimulus, those instincts can be triggered in many different settings. Even if the chase instinct is not triggered, dog presence in and of itself may be an agent of disturbance or stress to wildlife.

This analysis distinguishes between stray and feral dogs and pets that are uncontrolled, free-running, or unrestrained. Stray and feral dogs are those not receiving care or sustenance from humans. Uncontrolled, free-running, or unrestrained dogs do receive food and shelter from their owners and are companion animals but, on occasion, are unaccompanied or uncontrolled. This definition could be met either inside or outside the context of recreational activity. The focus of this analysis is on the circumstances in which recreationists take their dogs with them and suggest that the domestic dog is an additional agent of disturbance that extends the zone of influence for human activities. Others have suggested that outdoor enthusiasts consider the ethical aspects of their outdoor recreational pursuits, some specifically mentioning dogs (Waterman and Waterman 1977, Watters 1978, Williams 1978, Leave No Trace 1997). Fischer and Fischer (1990) devote a section to responsible wildlife viewing. They describe potential consequences of approaching animals too closely or too persistently, such as separating mothers from their young or flushing incubating birds from their nest. While the authors do not specifically mention pets, the presence of a leashed dog or a loose dog can generate the same consequences. In a chapter devoted to safe and responsible viewing, Duda (1995) suggests that wildlife watchers leave their pets at home for these very reasons.

Typically, the prevailing rationale for dog restrictions, where they do occur on national forest lands, rests on the potential disruption to the experiences or safety of other recreationists rather than concern about disturbance to wildlife. In national parks, pets are typically restricted to developed human-use facilities to limit disturbance to wildlife and for human safety. Certain U.S. Fish and Wildlife Service lands are restricted to all access during nesting seasons, opening to all uses, including pets, during the remainder of the year. While there is variation in agency response and regulation and from site to site, under certain circumstances, dog disturbance to wildlife in and of itself may justify restrictions (leash restraint or total exclusion) for recreationists in wildlife habitats.

Knight and Cole (1995) recommend that recreational activities not be considered in isolation and that when more than one recreational activity occurs simultaneously, there could be unanticipated synergistic effects. Similarly, wildlife populations could suffer from the accumulating impacts of rural development and increased interest and participation in outdoor recreation. According to Ray Rasker of the Sonoran Institute (cited in Cowan 1999), people first decide where they want to live, then either find a job, create a job, or live on non-labor (investment or retirement) income. It is no secret that increasing numbers of people choose to live in the Rocky Mountain region because of quality-of-life attributes, clean air and water, hunting, fishing, wildlife viewing, scenic views, and other outdoor recreation opportunities. Gallup polls indicate that 60% of Americans over the age of 50 dream of retiring in a small town or rural county (Thrush 1999). In fact, the human population of counties in the Upper Columbia River Basin increased 96% in the early 1990s. The greatest increases occurred in "recreation" counties where

recreation and tourism constitute a large portion in the economy. These counties accounted for 24% of the population increase in the area (U.S. Department of Agriculture 1996). With increasing interest in outdoor recreation and homesite development in rural settings close to outdoor recreational amenities, it is conceivable that unrestrained dogs accompanying recreationists could become an issue of biological significance. While current problems may represent isolated cases at a localized scale, the convergence of increased recreation and rural development could be synergistic. It is difficult to segregate human demographic trends from trends in rural development and outdoor recreational participation, particularly in settings like the West where they appear to be interrelated.

Potential impacts of domestic dogs on wildlife could be broadly classified as harassment, injury, or death. Harassment is the disruption of normal maintenance activities, such as feeding, bedding, or grooming. It can take the form of disrupting, alarming, or even chasing. If dogs chase or pursue wildlife, injuries could be sustained directly or indirectly as a result of accidents that occur during the chase itself rather than direct contact with the dog. Domestic dogs can thus be directly or indirectly responsible for wildlife mortality. Potential impacts to wildlife by domestic dogs also include displacement of wildlife from public to private lands and modification of wildlife behavior (as described in the ungulate chapter). The role of dogs in wildlife diseases is poorly understood. However, dogs host endo- and ectoparasites and can contract diseases from, or transmit diseases to, wild animals.

There are few published papers on simulated disturbance trials using leashed companion animals in recreational settings. Some literature does address feral or stray dogs; other papers did not make a distinction but noted problems or issues associated with dogs. While much of the research did not specifically investigate disturbance of wildlife by dogs with recreationists, under-supervised dogs could function as an agent of disturbance, generating similar consequences as stray or feral dogs. Dogs also function as an extension of their owner. Particularly while off-leash, dogs increase the radius of human recreational influence or disturbance beyond what it would be in the absence of a dog. In addition, the predictability of disturbance is diminished when dogs are off-leash. Furthermore, canids are natural, evolutionary predators of many wildlife species, and the resemblance between domestic dogs and wild canids may elicit similar responses in those wildlife species.

Because animal responses are so variable and occur in a full spectrum ranging from the direct and obvious to the covert and physiological, documenting wildlife response to human recreation is challenging. Even within a species, findings are often mixed or inconclusive. Investigations have focused on short-term responses, while long-term responses leading to potentially more serious consequences have not been studied. Furthermore, much of the work to date has focused on effects on individual animals, while impacts to the population, which are more difficult to document, have not been addressed. Potential effects to populations either go uninvestigated, are extrapolated from individual-scale results, or are hypothesized to occur with little supporting evidence. Research into wildlife response to cause-specific disturbances, such as loose domestic dogs, is even more problematic. While potential impacts for many species (such as ungulates) likely occur at the individual scale, other species or localized geographic areas may experience more significant effects. Even at the individual scale, impacts should not be summarily dismissed as insignificant, particularly in light of the limited information available at present.

There are theoretical reasons for concern and a need for increased awareness of this issue. Individual species biology, life history requirements, species distribution, animal abundance, animal density, habitat use patterns, seasonal considerations, and spatial scale dictate these reasons. Fish and wildlife agencies have traditionally focused on coarse levels of resolution when evaluating agency actions. Wildlife managers frequently think at the "population" level. However, more narrow levels of evaluation may also be warranted in some situations – down to the "individual" level. Increasingly, the general public expresses its interests and concerns at a narrow or local level, based on personal values, experience, and preferences. Some publics place great value on the individual wild animal, regardless of its contribution to a larger population, and they clearly expect agency responsiveness to their concerns about individual animal welfare. Conversely, federal land managers have traditionally evaluated proposed agency actions on a localized or "unit" basis. Recently, greater emphasis has been placed on analyzing proposed actions across larger land areas or watersheds (Amy Hetrick Jacobs, Flathead National Forest, personal communication, 1999). Nonetheless, there is a contrast between input received from individuals who express concern about 1 trail or stand of trees and input received from organizations which focus comments at the watershed level. In the context of recreational disturbance to wildlife, both levels of analysis are warranted.

EVOLUTION OF THE ISSUE IN THE LITERATURE

In the literature, documentation about dogs harassing wildlife dates back to the early 1950s. These early references were solely related to white-tailed deer. In the eastern states, hunters and many state management agency personnel perceived game populations, particularly white-tailed deer, as limited by predation and harassment by domestic dogs (Ward 1954, Giles 1960, Cochran, 1967, Houston 1968, Morrison 1968, Colorado Division of Wildlife 1973). Predation by free-running dogs was believed responsible for the perceived slow growth rate of existing and translocated populations. Many of these articles were sensational dramatizations or anecdotal arguments, commanding agency personnel to "do something" about the problem. This tone persisted despite the lack of empirical evidence substantiating the concern. The situation in the Southeast was further inflamed by a regional tradition of using dogs to hunt deer. Progulske and Baskett (1958), investigating the mobility of marked white-tailed deer in Missouri, found that hunting hounds harassed deer year-round and that the ultimate effects of the steady harassment could not be evaluated.

It was not until the 1970s that a more systematic approach was undertaken to examine the issue. This early work was intended to evaluate dog-hunting techniques used for deer in the Southeast, where deer hunting included a tradition of running deer with scent-trailing hounds. Perry (1970) studied the movements and activities of dogs owned by rural residents and concluded that deer mortality by dogs was neither large nor significant in influencing deer population dynamics in Virginia. However, he noted that 70% of the dogs trapped or observed during his study were hounds. Gavitt (1973) experimentally chased deer with hounds and non-hounds on the Radford Army Ammunition Plant, Virginia. He found hounds to be more effective and persistent trailers while non-hounds were generally faster. According to Gavitt, dogs did not limit the deer herd's reproduction or induce permanent changes to home ranges.

Some of the most detailed literature on the behavior of free-running companion dogs is reported by Sweeney et al. (1971) and Corbett et al. (1971). Their subjects were purebred dogs selected for their hunting ability in the pursuit of white-tailed deer. Sweeney et al. (1971) stated that hunting hounds are specifically trained to run deer and vocalize regularly while trailing deer and cautioned that the behavior of other free-running dogs (mixed breeds in a hunting context or domestic pets) is likely different. It could involve stalking, trailing silently, or chasing by sight.

Sweeney et al. (1971) examined the responses of radio-marked white-tailed deer chased by hunting hounds in a southeastern coastal plain environment with streams and swamps. They reported average chase times of 33 minutes (range 3-155 minutes) and an average chase distance of 2.4 miles (range 0.2 – 13.4 miles). Deer left their home ranges in 78% of the experimental chases, generally returning within one day. The authors also stated that as deer population density increased, chase duration decreased because of the greater probability that hounds would switch to the trail of another deer. One unexpected finding was that instrumented deer responded to disturbance created by hounds chasing other uninstrumented deer and moved measurable distances away. Sweeney et al. (1971) cautioned that free-ranging dogs (non-hounds) might exhibit different chasing behaviors by stalking, trailing silently, or chasing by sight or scent. They further cautioned that their results might not apply in rugged mountainous terrain or areas with snow cover. No dog-induced mortality was documented for their study animals.

Corbett et al. (1971) conducted a similar study using hunting hounds in the mountainous terrain of western North Carolina. They recorded an average chase time of 54 minutes (range 4-165 minutes) and similar chase distances as Sweeney et al. (1971). In 70% of the cases, deer left their home ranges, resulting in longer chases than those in which the animal did not leave its home range. In about 50% of the cases in which deer left their home range, deer took longer than one day to return and, in some cases, considerably longer than that for white-tailed deer in coastal plain habitats. The authors noted that deer seemed to suffer physical injury more frequently while being chased in mountainous terrain because of the complex physiography. Dog-related mortality was documented. For one mortality incident, the deer appeared to suffer from parasitic damage to its lungs, rendering it "incapable of sustained running whereby it could have eluded dogs." Corbett et al. (1971) speculated that in mountainous habitats, deer could have been under greater physical stress, on a poorer nutritional plane, or otherwise weakened and more susceptible to dog predation. They concluded that dogs "may have a significant impact on populations."

In a survey of state and territorial departments of agriculture and wildlife/natural resources, Denny (1974) found that 86% of the wildlife agencies considered uncontrolled companion animals a problem for wildlife. Wildlife agency respondents listed damage to wildlife as the highest-ranking problem, affecting deer, small mammals, and birds (in

descending order o f importance). Predictably, agricultural agencies listed damage to livestock as the greatest problem with uncontrolled companion animals. Wildlife respondents lacked data on the extent of losses or damages and the economic value of losses, whereas agricultural respondents could estimate economic losses. Mosby (1973), as cited by Denny (1974), concluded that definitive data on the influence of dogs on all forms of wildlife were all but impossible to attain. Nonetheless, Denny (1974) concluded, "It is apparent, though not well-documented, that the impact of dogs (and cats) can be detrimental to wildlife under specific circumstances, depending on the wildlife species involved, the relative populations of predatory and prey species, other mortality factors, habitat factors (quality, physiography, geographic location) and land use (the incursion of developments into wildlife habitats)."

Denny (1974) also cautioned: "In the Rocky Mountain region and similar regions of high snowfall, the concentration of big game on limited winter ranges provides an excellent opportunity for dog predation. This is becoming more prevalent in skiing and other recreational areas, as well as in mountain home development areas."

In more contemporary literature, domestic dogs are frequently cited as agents of mortality in ungulate research (Gavin et al. 1984, Sarbello and Jackson 1985, Nelson and Woolf 1987, Fuller 1990). Mortality attributed to domestic dogs has been documented in winter (adults and fawns) and in spring (prior to recovering physical condition post-winter) for all ages and neonates. These studies attributed 2-3% of annual mortality to domestic dogs. The researchers did not know whether the dogs were companion animals owned by nearby landowners or by recreationists or were stray/feral animals, as many of these studies were conducted on national wildlife refuges or similarly designated wildlife management areas used by the public. None of the authors concluded that domestic dogs were a significant or determining influence on population dynamics, but they discussed domestic dogs as predators. Some researchers distinguished between domestic dogs and other predator species and treated them separately. Others, such as Nelson and Woolf (1987), were unable to distinguish between coyote and domestic dog predation and combined the two into one category.

Sime and Schmidt (1999) reported that a free-running domestic dog (with collar) was photographed at two locations by remote camera stations approximately 1.5 miles apart on the same day. This particular dog was also photographed on 3 other occasions within a two-week period at locations up to 2.5 miles apart. This dog was likely owned by a landowner adjacent to the study area, but this is unconfirmed. The cruising radius of rural pet dogs could be up to 3 to 5 miles (D. Swanson, Animal Control Officer, Flathead County, Montana, personal communication, 1999). The behavior of domestic dogs while at large or while off-leash in a recreational setting is undocumented in the peer-reviewed literature. Anecdotal evidence suggests that dog behavior while at large or off-leash and in a recreational setting varies with training, breed, experience, stimuli encountered, and owner attitudes.

The presence of domestic dogs may introduce diseases or parasites to small mammals, and the burrows of fossorial mammals can be physically damaged as a result of domestic dogs (Stuht and Youatt 1972, Thorne et al. 1982, Durden and Wilson 1990). In addition, dogs walking across burrows caused alarm reactions (Mainini et al. 1993). In the case of birds, the presence of dogs may flush incubating birds from nests (Yalden and Yalden 1990), disrupt breeding displays (Baydack 1986), disrupt foraging activity in shorebirds (Hoopes 1993), and disturb roosting activity in ducks (Keller 1991). Many of these authors indicated that dogs with people, dogs on-leash, or loose dogs provoked the most pronounced disturbance reactions from their study animals.

As there are life history stages of various wildlife species in which disturbance by domestic dogs could cause particularly pronounced impacts, the following sections address potential effects by season. Where possible, published literature specifically related to dogs is presented to demonstrate impacts. In the absence of published literature, potential impacts from domestic dogs are speculated, as indicated.

POTENTIAL IMPACTS, WINTER – EARLY SPRING

Ungulates

For many species in northern latitudes, the winter season presents significant challenges for survival. Many species have adapted to winter conditions through development of migratory movements to lower elevations, behavior modification, and physiological adjustments, all of which enhance overwinter survival. For ungulates, the stresses imposed by deep snow, food shortages, and low ambient temperatures combine to depress body condition. The

primary survival strategy used to mitigate these stresses is energy conservation. As described in the ungulate chapter, human activity on ungulate winter ranges generates a wide variety of responses, most of them negative. The most significant response is a forced movement away from the human disturbance, which is energetically disadvantageous to ungulates. Domestic dogs could promote forced activity in a manner consistent with non-motorized recreation.

Parker et al. (1984) suggested that greater flight distances occur in response to skiers or individuals on foot compared to snowmobiles and that unanticipated disturbance may have a more detrimental effect. Freddy et al. (1986) and Freddy (1986) also reported that responses by mule deer to persons afoot, when compared to snowmobiles, were longer in duration, more often involved running, and required greater energy expenditures. Loose domestic dogs may function as an unanticipated disturbance, undetected until at a range close enough to be registered by the senses of the wild ungulate. This is in distinct contrast to the sound of a snowmobile, which is detected by the animal while it is still some safe distance away. If a human was accompanied by a loose dog, forced activity could be more protracted spatially and/or temporally if the individual animal was being chased by the dog. (Readers are advised that there are limited published references in the context of loose companion animals to substantiate this suggestion.)

Sime and Schmidt (1999) documented a statistically significant increase (during a 10-year period) in dog presence on a publicly owned white-tailed deer winter range that has attracted increasing numbers of recreationists from a nearby major population center. Eighty-nine percent of free-running dogs detected by remote camera systems were companion animals, as evidenced by collars and good body condition. Photographic evidence of dogs chasing deer was also obtained. Sixty-six percent of the photographs were taken during daylight hours. It is not known whether those dogs belonged to nearby rural homeowners or were accompanying, off-leash, their recreating owners who remained undetected by the cameras. Nonetheless, the ability and success of domestic dogs in harassing, injuring, and killing white-tailed deer on this winter range has been documented (Sime 1996).

In a study of bighorn sheep, which were already partially habituated to humans, MacArthur et al. (1982) conducted human-disturbance trials in which a person approached a group of sheep from a road, from the road accompanied by a leased dog, and from a ridge away from the road. The authors recorded the strongest negative reactions in the sheep when a human with a leashed dog approached. Furthermore, the researchers did not observe a reduction in heart-rate response with repeated trials. Heart-rate response actually increased successively in the leashed-dog trial. In earlier work, MacArthur et al. (1979) found that free-ranging dogs and coyotes evoked the maximum heart-rate responses. Among all the stimuli they studied, MacArthur et al. (1982) concluded, "The presence of dogs on sheep range should be discouraged."

Effects of disturbance on moose have been researched primarily in the context of oil and gas extraction (Rudd and Irwin 1985) and mining (Westworth et al. 1989). Results of these studies were summarized in Olliff et al. (1999). In general, Shank (1979) reported that moose appeared to be relatively tolerant to human approach, as indicated by flight distances. However, the flight behavior of moose is often misinterpreted because it is frequently more subtle than that of other ungulates. Shank (1979) noted that moose would commonly not react immediately and overtly to disturbances unless the stimulus was intense. While seemingly unaffected by the stimulus, moose would move toward cover. Not until reaching cover would the moose look directly at the source of the disturbance, then run. Physiological responses such as increased respiratory or heart rates were probably taking place all along, though not obvious to observers. While most studies of moose disturbance in winter demonstrate changes in movements and habitat use, no studies have documented demographic effects.

In western Wyoming, Rudd and Irwin (1985) documented disturbance response by moose to trucks associated with oil and gas extraction, snowmobiles, and to people on snowshoes or skis. Although dogs were not specifically included in the trials, results are suggestive of minimum threshold values for disturbance; more pronounced reactions or shorter flight distances could be expected if domestic dogs accompanied the foot-based recreationists. People on skis or snowshoes caused more disturbances to moose than snowmobiles. Non-motorized winter recreational activities caused 89% of monitored moose to be displaced, while snowmobiles caused 50% displacement, and trucks caused 21% displacement. Furthermore, 100% of observed moose demonstrated disturbance behaviors when disturbed by skiers and snowshoers, moving an average of 80 yards away. In contrast, 94% of moose moved 50 yards when disturbed by snowmobiles. As for other ungulate species, moose also seem

more sensitive to unanticipated disturbances. Rudd and Irwin (1985) recommended that winter recreational use and mining activity is restricted near preferred moose winter range.

While moose show some propensity for habituation to humans, flight and stress responses in moose are most likely when disturbances are unpredictable, intense in sensory perception, and close in proximity (Olliff et al. 1999). Negative impacts of responding to disturbances include increased energy expenditures before, during, and after flight and reduced foraging time. The very presence of domestic dogs could theoretically intensify moose response to winter recreationists. Dog behavior is unpredictable and dogs could encounter moose at close range unexpectedly. From an evolutionary perspective, wild canids are natural predators of moose. Unless habituated, moose may perceive domestic dogs as similar to wild wolves and respond accordingly with a standing defense rather than a flight response. It was recommended in Olliff et al. (1999) that public education includes the potential impact of dogs on moose.

Gavitt (1973) summarized research on domestic animals that suggested that elevated body temperatures at conception and during early gestation could influence embryonic viability (Hulet et al. 1956, Vincent and Ulberg 1965, Ulberg and Burfening 1967). Furthermore, Shelton (1964) (as cited in Gavitt 1973) reported low birth weights and increased lamb mortality resulting from the effects of high temperatures during gestation, although in this study heat stress was related to ambient temperatures rather than body core temperature. Hulet et al. (1956) reported that any factor that tended to increase body temperature, including exercise, tended to reduce fertility in sheep. Whether elevated body temperatures in wild ungulates actually decrease fertility or induce embryonic mortality is unknown. Many ungulate species enter the winter season having just completed the breeding season, and pregnant females would be in early gestation.

In a personal communication (cited in Gavitt 1973), Downing stated that temperatures as high as 109°F were measured for 6 deer killed while being run by dogs. Normal rectal temperature for deer is 101°F (Clark and Jessup 1992). These authors caution that a rectal temperature of 106°F, in a capture situation, is of concern and attempts should be made to cool the animal. Body temperatures exceeding 108°F constitute an emergency situation, and treatment should begin immediately. If temperatures exceed 110°F, mortality is very likely. Normal rectal temperature for elk is similar to deer whereas normal temperature for bighorn sheep is 98-99°F. In general, body temperatures elevated by exercise and stress-induced physiological complications (such as elevated respiratory rates) can be triggered by human disturbance, and may be exacerbated by the presence of domestic dogs.

Bighorn sheep vulnerability to human disturbance and the more pronounced negative impacts to them if dogs accompany humans have been documented. The documentation to date mostly describes changes in physiological parameters, behavior, or displacement. However, because the breeding season occurs in early winter, there could also be population demographic effects if sheep are disturbed during the breeding season, which corresponds with the onset of winter cross- or backcountry skiing.

The negative impacts of disturbance and harassment by humans and their companion animals would logically become more pronounced as winter conditions become more severe. Readers are referred to the ungulate chapter for additional discussion of this topic. At present, only the work of Corbett et al. (1971) in western North Carolina describes outcomes of experimental chases in winter season and "extremely hilly terrain." Most of their study area was below 4,400 feet and was comprised of northern hardwood forest (oak and oak-pine) and spruce-fir forest types interspersed with food plots. Outcomes in harsh Rocky Mountain winter environments could be more severe.

The ungulate chapter emphasizes the importance of early spring in assuring recovery from winter weight loss. The authors caution that despite warming temperatures and reduced snow depths, until green forage is available in sufficient quantities and animals begin reversing the winter-induced decline in physical condition, ungulates remain susceptible to the negative effects of disturbance. Human presence in this context, particularly by antler collectors who employ their dogs in the search, can cause ungulates to succumb to stresses that would be considered minor at other times of the year.

Other Species

In winter, wolves localize their foraging to ungulate winter ranges. Ungulates seem to be most vulnerable to winter human disturbance from skiers and snowshoers. Potentially, there would be more disturbance if pets accompany recreationists. Therefore, wolves could be indirectly influenced by redistribution of their prey base by humans and by humans accompanied by dogs. Packed snow trails created by snowmobiles, if routed to or through ungulate wintering areas, may in effect provide access to wintering ungulates by wolves or dogs (companion dogs with recreationists and/or residential dogs), thereby increasing disturbance and predation. In addition, there is the potential for direct encounters between wolves and domestic dogs. Although wolves demonstrate a wide range of response to human disturbance during all seasons, less tolerance is demonstrated while denning, which begins in early spring. Readers are referred to the wolf section for additional discussion of wolf – domestic dog issues.

Low population densities characterize mid-sized forest carnivores (e.g., marten, fisher, lynx, wolverine), low reproductive rates, large home ranges, secretive behavior, and, generally, low tolerance of human presence and activity. Although poorly understood, forest carnivores demonstrate a high degree of habitat specificity during some life stages. Therefore, these animals could be vulnerable to disturbance by humans in various spatial and temporal matrices, particularly if pets accompany humans. Companion animals may amplify negative responses of forest carnivores to human disturbance, although this topic has not been addressed in the literature. Readers are referred to the forest carnivore section for additional discussion. As an additional problem, domestic dogs can be vectors for transmission of such diseases as distemper, which also affect wild carnivore species.

POTENTIAL IMPACTS, LATE SPRING/SUMMER

Companion dogs extend the radius of human recreational influence in the landscape. During summer, concerns are primarily related to the birth and rearing of young for all wildlife species. While dog impacts likely occur at the individual scale because of lower summer densities of wildlife populations relative to winter, the results may still have important implications for the wildlife populations. Potential impacts on reproductive performance at the individual and population level vary by species, abundance, habitat use, the specificity of habitat requirements during young-rearing phases, and the behavior and experience of the individual animal. Colonial nesters, for example, are sensitive to disturbance, and if disturbances are frequent enough or are of sufficient magnitude, an entire reproductive season could be forfeited by the colony.
Late spring and summer recreational activities that bring humans and their dogs into wildlife habitats include hiking, backpacking, bicycle riding, boating, horseback riding, camping, picnicking, wildlife viewing, outdoor photography, fishing, and firewood cutting. Because recreationists are no longer constrained by snow, impacts could be dispersed but broadly applied throughout the landscape, such as a trail network traversing a wilderness area or national park. Disturbance can also occur unexpectedly at established human recreation focal areas such as campgrounds. In one such instance, two small domestic dogs working together like wolves harassed a moose calf. The dogs made physical contact, though the calf apparently survived. This incident took place in mid-June 1997 at a campground located along a major highway. The dogs' owners stated that they were unaware of the incident (P. Finnegan, Law Enforcement Officer, Lewis and Clark National Forest, personal communication, 1999).

In addition, particular summer habitats and associated wildlife species could be more vulnerable to disturbance by recreationists and their pets. Sensitive alpine environments are readily accessed and sought out by enthusiasts. Because summer growing seasons are so short, physical disturbance by dogs (through digging or bed-making) could damage vegetation and soils, with resulting influences on vegetation, soils, and wildlife such as small mammal populations. Some wildlife species, such as mountain goats or bighorn sheep, are limited in their habitat choices by the need for security cover (i.e., steep topography). However, these preferred summer habitat features are also sought out by recreationists for the "view," resulting in disturbance or displacement. Domestic dogs could especially impact alpine wildlife species because alpine environments are isolated and have a patchy distribution in the landscape.

Not traditionally considered a dispersal agent for noxious weed seeds, domestic dogs do pick up and transport seeds in their hair and paws. While the scale of noxious weed seed transport by dogs is small compared to that of motorized vehicles, dogs can travel and deposit seeds in locations far removed from roads and trail systems. Because these areas are not traveled as frequently as roads, emerging weed plants may go undetected and not be

treated in a timely manner. Readers are referred to the vegetation and ungulate chapters for a more thorough discussion of noxious weeds.

Pet food is known to attract many species of wildlife, including bears, squirrels, jays, and raccoons. The issue of pet food storage is important at campgrounds as well as in remote backcountry settings. Wild animals that obtain improperly stored foods may become habituated, with predictable outcomes as described in the various species chapters.

There are limited published references addressing human recreational disturbance to wildlife in summer, particularly when human recreation is coupled with companion dogs. However, as with winter-based disturbances, potential impacts can be anticipated by managers based on species biology, seasonal activities and requirements, and reasonable assumptions. Unanticipated disturbances involving foot-based recreationists with their dogs may elicit the greatest stress reactions. Consequences would then be commensurate with the intensity of disturbances, their frequency, and their timing. The following sections summarize published literature.

Ungulates

The ungulate chapter presents a thorough review of general seasonal biology and published literature related to human disturbance and its potential impacts during summer. The vulnerability of ungulate species to direct and indirect injury or mortality from domestic dogs has been previously discussed. Of particular note, however, is the vulnerability of neonatal ungulates (up to e weeks of age) to harassment, injury, or mortality by dogs (Dood 1978, Nelson and Woolf 1987). This window of vulnerability corresponds to the period that newborns hide, attain mobility, then increase activity but remain too slow to evade chasing canids. Disturbance by recreationists and their dogs may render ungulates more vulnerable to naturally occurring wild predators such as coyotes, which track human scent. It may also disrupt visitation by lactating mothers.

Ingold et al. (1993) reported responses of chamois in the Swiss Alps to the presence of hikers. Chamois are an alpine-dwelling, ecological relative of North American mountain goats. With moderate trail-hiking disturbance, male chamois altered their use of a preferred grazing area, avoiding the area altogether when hikers were present.

In Olliff et al. (1999), it was noted that moose have difficulty dissipating heat because of their large body size and heat stress could reduce overall activity during warm periods. Ambient air temperatures above 57°F can cause moose to seek out cooler areas. Renecker and Hudson (1986) reported that moose increased their respiration rate when ambient temperature exceeded 57°F, stating that moose are easily heat stressed. Similarly, elk reduced their activity after temperatures exceeded 75°F (Lieb 1981). Metabolic rates of caribou were lowest in February and highest in May (Chappel and Hudson 1978). Disturbance and/or forced movement during summer may be more problematic than during winter for many ungulate species from a physiological perspective because of a greater sensitivity to heat stress. As physical activity can increase body temperatures, ungulates may suffer physiological complications from being harassed by a dog in summer.

Other Species

Bird species are variously affected by human disturbance, as described in the bird chapter. In many cases, pedestrians generated the most negative responses (Hanson and Grant 1991), and the presence of dogs may intensify bird responses to pedestrians. Dogs themselves can disrupt habitat use, cause similar displacement responses, and injure or kill birds. Some published literature is summarized below to demonstrate the spectrum of potential impacts. Readers are also referred to the bird chapter for additional information.

Burger (1986) described the effects of human activity on shorebirds in two coastal bays of New Jersey between late April and late October. People walking accounted for 43% and 50% of bird disturbances in the two bays, respectively. Other disturbances noted were fisherman, airplanes, dogs, clam diggers, off-road vehicles, boats, children, and joggers, in descending order of occurrence frequency. Results indicated that more shorebirds flushed as the total number of disturbances and the number of children, joggers, people walking, dogs, aircraft, and boats increased. The number of human disturbances was high between May and August, coinciding with peak numbers of shorebirds. Fewer birds remained on the beaches during disturbances from late May to early August.

In a study of piping plover ecology and responses to human disturbance, Hoopes (1993) documented that adult plovers and their chicks spent 8% and 15%, respectively, of their time responding to human-related disturbances. Human-related disturbances to plovers were quantified as follows: pedestrians 86%, pets 7%, off-road vehicles 5%, and kites 2%. Pedestrians within 50 meters of study birds caused them to stop feeding 31% of the time, while pets within 50 meters caused birds to stop feeding 52% of the time. Plovers responded to pedestrians and pets at 23 meters and 46 meters, respectively. Although Hoopes documented a 33% mortality rate for chicks, neither the percentage of chicks fledged nor the mean number of chicks fledged per pair was significantly correlated with disturbance rates. The cause of death for 10 chicks was attributed to predation by a house cat (n=3), predation by a herring gull attracted by a fisherman (n=3), human disturbance or handling (n=3), and being run over by an off-road vehicle (n=1). Hoopes (1993) recommended management actions that restrict dogs and off-road vehicles, provide refuge areas for chicks, and apply symbolic fencing to reduce the impacts of disturbance on chick survival.

Yalden and Yalden (1990) similarly studied nesting and rearing ecology of golden plovers in relation to human disturbance. Golden plovers were sensitive to the presence of people within 200 meters and flushed more often during the pre-incubation period. Once incubating, golden plovers remained on the nest 96% of the time when disturbed but would have incubated 98% of the time in the absence of disturbance. During this phase, plovers flushed more readily in response to dogs than to people and took longer to resume incubation if people or dogs were still present. Once hatched, chicks hid in response to alarm calls from parents, neither able to feed nor be brooded. Adult plovers spent about 11% of the observation day responding to people, flying more often and increasing energy expenditures by 15%. Some plover pairs opted for intraspecific interactions rather than remaining in areas vulnerable to human disturbances. Pairs did this by moving chicks to quieter areas and encountering resistance from occupants of the territories they had invaded.
While studying the effects of human disturbance on eider ducklings, Keller (1991) found that ducklings were disturbed while roosting on the shoreline and while feeding in water. The shore-based activities (fishing, people walking, dogs) caused more disturbance than water-based activities (windsurfing, boating). Disturbance affected the activity of young eiders for up to 35 minutes. Keller (1991) reported that small ducklings experienced a numerical increase in predator encounters during the first 5 minutes post-disturbance.

Males of some gallenacious bird species establish territories on leks and are visited by females for courtship and mating purposes during the spring breeding season. Females visit leks during a narrow window of time, and most breeding takes place within a 1-2 week period. Species demonstrating this pattern include sage grouse, sharp-tailed grouse, and prairie chickens. Baydack (1986) experimentally disturbed sharp-tailed grouse using parked vehicles, snow fencing, propane "bangers," scarecrows, radio sounds, human presence, and leashed dogs. Male sharptails tolerated all experimental disturbances and continued to display, except when disturbed by visible human presence and leashed dogs. With human presence, males flushed from the lek but generally remained within 400 meters of it and returned within 5 minutes following cessation of the disturbance. In contrast, female sharp-tailed grouse were much more sensitive, being displaced from leks by all tested disturbances. Unfortunately, females were not monitored, so whether they returned upon cessation of the disturbance is unknown. Patterson (1952) reported that male sage grouse would flush as a human entered a blind but would return 20-30 minutes later so long as the initial disturbance took place prior to twilight. If disturbed during morning dawn or later, birds did not return until the next display period. Because of high lek fidelity and the persistence of individual leks through time, disturbance of birds during this sensitive life history phase has important implications for population productivity, long-term population viability, and the perpetuation of viable leks into the future. Because females attend leks for such a brief period of time, disturbance could potentially influence nesting chronology and fecundity for a local bird population.

In a study of tourism in the Swiss Alps, Ingold et al. (1993) conducted disturbance trials on ptarmigan. The authors demonstrated that nesting ptarmigan a depressed slow heart rate when a hiker approaches the nest. Hens exhibit similar reactions during the breeding season in the context of predator avoidance.

Other species may be affected by summer recreational activities, as well. In the same study, marmots were experimentally disturbed by hikers on-trail, off-trail, and those accompanied by dogs. Marmots demonstrated a greater reduction in their flight distances than expected in response to hikers (Ingold et al. 1993), however, responses were more pronounced for hikers off-trail and hikers with dogs. Mainini et al. (1993) reported similar findings in their study of marmots in the Swiss Alps. Marmots reacted differently to various tourist-hiking regimes. The smallest disturbance reaction was noted when hikers restricted themselves to trails. Increasing reactions were noted with cross-country hiking and subsequent crossing of main burrows. The most severe reactions were

documented in trials with dogs on a leash. Marmots gauged their responses by the predictability and nature of the potential threat (Mainini et al. 1993).

DISEASES AND PARASITES

Domestic dogs can potentially introduce various diseases and transport parasites into wildlife habitats. Furthermore, dogs can transmit diseases and parasites to wild animals directly and *vice versa*. In some circumstances, effects of diseases or parasites on wildlife are manifested in isolated areas with some limited illness or individual mortality. However, in other cases, such as with canine distemper, potential impacts are much more significant and are manifested in broader geographic areas and with real demographic effects. Generally, I assume that companion dogs are in good health, well cared for, and receive regular veterinary examinations; however, this is not always the case. While dogs can be vaccinated against many of the diseases listed below, adherence to recommended vaccination schedules is necessary for even adult dogs to maintain immunity. Specific concerns for wolves are noted in that chapter. Information presented in this section is taken from Thorne et al. (1982), unless otherwise cited.

Canine distemper occurs throughout the world, but Thorne et al. (1982) consider it "common" in the intermountain region. All canids as well as other carnivores and mustelids are susceptible to infection. Transmission occurs via direct contact between susceptible individuals and animals shedding the virus or by aerosol (inhalation of airborne droplets released by infected animals when coughing or sneezing). Mortality rates range from 20-100%, depending on the species. Canine distemper could be a significant limiting factor for carnivore populations and is generally fatal in ferrets. Contact between domestic dogs and wild carnivores may occur in the context of outdoor recreation, and the disease could be transmitted among species, though generally not to humans.

Rabies is an acute viral disease that can infect all warm-blooded animals, including humans, and it is generally fatal. It is transmitted by the bite of an infected animal, ingestion of infected tissues, inhalation of aerosols, and transplacental passage. Rabies was first reported in dogs in Florida in the late 1700s and was documented in western states beginning in the early 1800s. Though often thought of in the context of bats, skunks, and raccoons, rabies has also been documented in fox, other canids, moose, and deer. Outbreaks can result in extensive die-offs in wild populations throughout broad geographic areas, with many species affected. Of particular significance for rabies is the incubation period between exposure and clinical symptoms, which varies from 10 days to several months (Adrian 1981), with 2 to 3 weeks being more common. A dog owner may be unaware that his pet was exposed to rabies until clinical symptoms appear. Domestic dogs could introduce rabies into wild populations after exposure but prior to clinical illness. Furthermore, although infection rates in wild populations are generally very low, domestic dogs could contract rabies from an encounter with a wild animal and, in turn, expose other wildlife, pets, and humans to the disease.

Parvovirus was first documented in the United States in the early 1970s. It is now considered ubiquitous in the environment, though it currently exists in variant forms other than the original strain. All canines are susceptible, including domestic dogs, wolves, foxes, and coyotes. Transmission occurs through contact with contaminated feces, and animals are infectious for up to 2 weeks post-exposure. Because all adult domestic dogs can be considered "exposed" at least to some extent and have produced antibodies in response, canine parvovirus generally afflicts only puppies and adolescent dogs in the domestic population. However, this viral disease is life-threatening for all canines and if untreated results in death. Parvovirus was implicated in wolf pup mortality for wolves inhabiting the Glacier National Park area (Boyd et al. 1993).

Plague is an acute, infectious disease associated with rodents, rabbits, and associated carnivore and scavenger species. It is also transmittable to humans. Thorne et al. (1982) suggested that the reasons for increased incidence of human plague the 1970s were three-fold: a substantial increase in human population in Western plague areas, heavier use of recreation areas, and maintenance of "natural" landscapes around human structures. Plague is transmitted by the bite of infected fleas, by direct contact with infected animals, ingestion of infected carcasses or under-cooked meat, or by aerosol. Mammals demonstrate individual and interspecific patterns of susceptibility and resistance to plague. As such, implications for wild animal populations vary by species, although ground squirrels, ferrets, bobcats, hares, and prairie dogs can be heavily impacted by plague outbreaks in localized settings. Canids appear to be more resistant, showing little if any ill effects of plague infection directly although canids may be

indirectly affected by infection of a prey population and a subsequent decline in numbers. Felids, however, can become very ill with frequent progression to mortality. Domestic dogs can pick up infected fleas from small mammals, transporting the fleas to new, unexposed locations.

Giardia, a genus of protozoa causing intestinal disorders, is found worldwide, but the Rocky Mountain region is a "hot spot," primarily because of human association with outdoor recreation. Giardiasis can be directly transmitted from one animal to another when cysts are ingested with contaminated feed or water. Flies are also thought to transport cysts from fecal stools to food and water sources used by other animals and humans. It is doubtful that giardiasis is influential in wildlife population dynamics because even acute cases usually subside to a chronic nonclinical state, but it is important for human-health reasons. Thorne et al. (1982) considered infected pets as a source of infection for humans and as a vector introducing contaminated feces into an area.

Dog feces have also been implicated in the transmission of muscle cysts (*Sarcocystis* spp.), which can infect a variety of ungulate species including elk, mule deer, and white-tailed deer. While the carnivorous hosts are seemingly unaffected, ungulates may be adversely affected to the point of illness or death.
Leptospirosis is a bacterial disease that affects the kidneys and urinary tract. Many species of wildlife are affected, including small mammals, muskrats, white-tailed deer, antelope, moose, bobcats, foxes, beaver, raccoons, and skunks. This disease does not appear to strongly influence population trends, but it can result in mortality in localized areas. In 1977, the Center for Disease Control considered domestic pets as a possible source for human infections.

Finally, Thorne et al. (1982) describe various other ecto- and endoparasites that can be transported by domestic dogs. They include ticks, keds, tapeworms, and fleas.

CONCLUSIONS

Published data specific to wildlife disturbances attributable to companion dogs are lacking. Furthermore, because of concerns about animal welfare and treatment during scientific investigations, evaluation of direct dog harassment of various wildlife species may not be feasible. Experimental protocols may not conform to ethical standards set by oversight committees. Therefore, managers are urged to consider the following when evaluating recreational impacts: species biology, reproductive potential, abundance, density, distribution, degree of habitat specificity or reliance on certain habitat components, and predisposition and sensitivity to disturbance by other agents. For most species, if a "red flag" is raised by pedestrian-based recreational disturbance, it is also likely there could be problems associated with the presence of domestic dogs. Even though strong evidence may be lacking, managers should not dismiss the possibility.

There are many educational opportunities to inform pet owners of the potential impacts to wildlife from dogs and to encourage responsible outdoor recreation ethics. In conclusion, maintaining control of pets while in wildlife habitats lessens the potential of disturbance or injury to wildlife, wildlife mortality, and injuries to pets and their owners.

GUIDELINES/RECOMMENDATIONS

Guidelines are based on information presented in the species chapters. They were developed considering species life history, seasonal biology, interpretation and synthesis of published literature, personal experience with my own and others' dogs, professional judgement, and discussions with peers. I propose the following guidelines for minimizing dog – wildlife interactions.

1. Increase agency and public awareness through interpretive/educational materials about responsible pet ownership in the context of wildlife disturbance during any and all outdoor recreational pursuits.

2. Consider whether or not a site is sensitive to wildlife disturbance by dogs when evaluating recreational facility development, facility upgrade or expansion (e.g., expanded parking areas, restrooms, or when promoting recreation at specific sites). Also, evaluate landscape level effects on traditional migration routes or the relative scarcity of important habitats.

3. Prohibit dogs where human recreation takes place on publicly owned ungulate winter ranges. If exclusion is not feasible, at a minimum, dogs should be leashed. Voice command is not adequate.

4. Prohibit dogsledding on ungulate winter ranges. If dogsledding cannot be excluded, confine travel to designated routes.

5. Restrict antler collection and other recreational activities in which dogs are present until May 15th on ungulate winter ranges, which allows ungulates to naturally disperse from their winter ranges during and after spring green-up.

6. Keep dogs leashed while in sensitive wildlife habitats, such as waterfowl nesting areas, nesting colonies, alpine habitats, or where young are still vulnerable.

7. Secure pet foods at all times; treat it the same as human foods.

8. Address the potential role of domestic dogs in disease transmission to wildlife and *vice versa* in educational materials; information should include endo- and ectoparasites.

INFORMATION NEEDS

The behavior of domestic dogs while off-leash in recreational settings with their owners is undocumented in the peer-reviewed literature for any season. Anecdotal evidence suggests that dog behavior while off-leash and in a recreational setting varies with training, breed, experience, stimuli encountered, and owner attitudes. Documentation of dog behavior would aid in the validation or refutation of concerns expressed.

Where it has been investigated in simulated disturbance trials, the effects of dogs on wildlife were studied in the short-term for individual animals. A better understanding of long-term ramifications at the individual scale and the implications at the population scale will help managers meet the requirements of various wildlife species in the face of changing land-use patterns and human modifications to the environment. While research results will likely vary from setting to setting as in the eastern states, the results will help land and wildlife managers assess recreational impacts to wildlife species peculiar to western climates, physiography, and recreation patterns. Results would then be specific to wildlife species, their habitats, and the life history patterns that evolved in the Rocky Mountains. This lack of local insight provides all the more justification for managers to proactively consider domestic dogs in the recreation matrix.

Changing social values, perceptions, attitudes, and beliefs combine to create a dynamic and complicated operating environment for natural resource management agencies. Concurrently, human demographic trends, rural development, and increased outdoor recreation combine to create a changing landscape for wildlife. An enhanced understanding of the cumulative and synergistic effects of these trends by resource managers, integrated with an understanding of animal response, will help minimize impacts. Although very difficult to quantify and define, there may be thresholds at which recreational disturbance of any type (including presence of domestic dogs) transcends from the individual level to the population level. Those levels are unidentified at present.

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